Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

INVESTIGATION OF THE MOLE.

By THEO. H. SCHEFFER, Kansas State Agricultural College.

DESCRIPTION AND DISTRIBUTION.

THE mole which forms the subject of this discussion is usually referred to as the "common garden mole." It belongs to a genus (*Scalops*) which is distributed very generally over the eastern part of the United States, and the Mississippi valley as far west as the plains. There is not enough variation in type over this range to establish more than a single species (*aquaticus*), but four or five subspecies are recognized. The Kansas mole has usually been assigned to the subspecies *machrinus*, but from the large number of specimens I have examined I should feel more inclined to place it in the subspecies *intermedius* of Elliott. We may, therefore, designate our mole as *Scalops aquaticus intermedius.*

The variation in size among individuals taken in the same locality is not especially marked, but it is more noticeable when comparing specimens taken in arid and in moist regions, respectively. The following data apply to 100 moles taken at Manhattan:

Males (45 specimens):
  Average total length, 176 mm. (about 7 inches).
  Average length of tail, 30 mm. (about $1\frac{3}{16}$ inches).
  Average weight, 4 ounces.

Females (55 specimens):
  Average total length, 168 mm. (about $6\frac{5}{8}$ inches).
  Average length of tail, 30 mm. (about $1\frac{3}{16}$ inches).
  Average weight, 3 ounces.

In contrast to the slight variation in size among moles taken in the same locality is the marked variation in color. The dominant shade is a mingling of lead color and brown, but some specimens are darker than this and, on the other hand, some are a beautiful silver gray, or, perhaps, are tinged with purplish. I have taken at least two that were suffused all over with rich golden brown. On the average, about one-half of the moles taken here have certain regions of the body—particularly the nose, chin and breast—washed with a tinge of orange, or have distinct patches of this color on the head or belly. Some of these patches are yellowish or golden brown instead of orange, and occasionally one is nearly white. A common marking is a band on the nose. The patches vary in size from a mere streak to a blotch covering almost the entire area of the belly or head. The following data on color markings are from the same 100 moles discussed under the head of variation in size:

Males (45 specimens):

Number having orange or rusty-brown markings	27
Number marked on nose only	5
Number suffused or washed in part	18
Number having well-defined patches	6

Females (55 specimens):

Number having orange or rusty-brown markings	23
Number marked on nose only	12
Number suffused or washed in part	2
Number having well-defined patches	9

The distribution of moles seems to depend very largely upon the humidity of the climate and consequent conditions of the soil in any particular region. As will be shown later, the mole thrives best in a loose, moist soil abounding in grubs and earthworms. The hard, compact surface earth of arid and semiarid regions is not at all inviting to an animal that must make its living by plowing along beneath the feet of the more favored creatures that crop the grass. Though able, perhaps, to burrow wherever an earthworm can burrow, the mole could not thrive and maintain its numbers in regions where these worms were few and small in size.

The map exhibited gives the distribution of the genus *Scalops*. Two other genera, *Condylura* and *Parascalops*, occupy portions of this same territory. Between the shaded area on the map and a narrow strip bordering the Pacific coast there are said to be no moles. This statement must be taken with some reservation, however, for moles are to be found in decreasing numbers on the lowlands along the watercourses as far west, at least, as the 101st meridian. On a recent trip through the western part of Kansas I made careful search for evidences of moles in favorable spots along the Saline, the Smoky Hill and the Arkansas rivers and their tributaries. At Wilson, on the Saline, moles were fairly common in cultivated fields and gardens. They were also reported from the Experiment Station grounds at Hays. At Oakley I could find no traces of the animal, nor could I learn by inquiry of any resident who had ever seen one there. On the Smoky Hill I learned of a mole having been taken occasionally as far west as Logan county, but could find no traces of their work myself. Residents on the river at Wallace assert that there are no moles in the country. At Garden City, on the Arkansas, moles were sufficiently numerous to be troublesome in lawns. A specimen taken at Great Bend did not seem to differ in any respect from those collected at Manhattan.

THE MOLE'S GUESTS.

Whether willing or not, the mole finds himself compelled to act as host to a large number of guests that throng his hallways. The maze of passages that thread the soil everywhere furnishes concealment and lines of traffic to several species of small mammals not favored by nature with the means for digging runways of their own. What the mole's attitude towards each species of these intruders may be I have not been able to discover. In the case of the shrew, I would infer it to be one of hostility, for the shrew and the mole are on the lookout for the same kinds of food. The shrew is generally supposed to do some burrowing on his own account, but I have trapped any number of the little animals in runways that from their size and general appearance were undoubtedly constructed by moles. In fact, I have more than once found a trap holding a dead shrew pushed up by fresh mole work almost out of the small excavation I had made. Whether tolerated or not, the shrew by no act contributes to blackening the reputation of his host as do the other guests — mainly voles (meadow mice), white-footed field mice and the common house mouse. These latter are directly responsible for most of the thefts of grain, seeds and tubers commonly laid to the charge of the mole.

BREEDING HABITS.

Though one of the most abundant of our small mammals, the mole is a slow breeder. This we would expect of an animal withdrawn from the strife and competition that reddens tooth and claw in the world above his secluded burrows. As will be seen from the accompanying table, the number of young at a birth is normally four, and but one litter is produced anually. These facts were ascertained from the examination of a large number of females — 101 — taken in all months of the year. Thirty-three of these were either pregnant or gave indisputable evidence of having recently born their young. The first specimen of this latter number was trapped February 27; the last April 20.

It would appear, then, that in this vicinity (Manhattan) the young are produced within a period of three to five weeks, mainly in March and early in April. The period of gestation must be comparatively short, for signs of pregnancy did not appear until about five weeks before the first females gave evidence of having born their young. I must admit, however, that my data on this point are not full enough to warrant a positive conclusion; for, of the twenty-five moles trapped during the months of December and January, and up to February 27, only five were females. This fact itself may be significant of a period of seclusion or less activity among the females during the period of pregnancy.

While, as above stated, the normal number of young is four, there were two cases in which there was but a single fœtus in one horn of the uterus; the other horn contained two, as usual. In one instance, also, there were five fœti.

That development after birth is quite rapid is shown by the litter of young moles referred to in the last item in the accompanying table. These were discovered in a nest of dry grass, under some sod, April 22. The sod had been turned over by the plow only about ten days previously. Although still perfectly hairless, these young moles weighed one ounce each—from one-fourth to one-third the weight of the adult. In all my trapping I have taken but three or four moles that seemed to be undergrown.

Results of the Examination of 38 Female Moles for Breeding Conditions.

Date.	Conditions for Breeding, Number of Embryos, etc.
Dec. 11	No signs of pregnancy.
Dec. 17	No signs of pregnancy.
Feb. 6	No signs of pregnancy.
Feb. 20	No signs of pregnancy.
Feb. 22	No signs of pregnancy.
Feb. 27	Uterus congested; very evidently pregnant.
Feb. 27	Uterus very much congested, but fœti not distinguishable.
Feb. 27	Uterus very much congested, but fœti not distinguishable.
Mar. 6	Uterus very much congested, but fœti not distinguishable.
Mar. 7	Three fœti in one horn of uterus, two in the other; scarcely distinguishable.
Mar. 8	Pregnant. Number of fœti probably four; scarcely distinguishable.
Mar. 8	Two fœti in each horn of the uterus; very small.
Mar. 8	Pregnant, but number of fœti not distinguishable.
Mar. 18	Pregnant, but number of fœti not distinguishable.
Mar. 22	Pregnant, but number of fœti not distinguishable.
Mar. 26	Pregnant, but number of fœti not distinguishable.
Mar. 29	Pregnant, but number of fœti not distinguishable.
Mar. 30	Two fœti in each horn of the uterus; about as large as navy beans.
Mar. 30	Two fœti in each horn of the uterus; about as large as navy beans.
Apr. 1	Two fœti in each horn of the uterus; a little smaller than the above.
Apr. 2	One fœtus in right horn of the uterus, two in the left; size of hulled peanut.
Apr. 8	Indications that the young had been recently born.
Apr. 9	Two fœti in each horn of uterus; size of navy bean.
Apr. 10	Indications that the young had been recently born; milk in glands.
Apr. 11	Three fœti; size of small navy bean.
Apr. 13	Four fœti; quite small, but easily distinguishable.

Apr. 13...Young evidently recently born; uterus flabby and veins congested.
Apr. 14...Young evidently recently born; the number of fœti had been four.
Apr. 14...Young evidently recently born; the number of fœti had been four.
Apr. 14...Young evidently recently born; the number of fœti had been four.
Apr. 15...Young born; evidences of being suckled.
Apr. 16...Young evidently born.
Apr. 17...Young born; number of fœti had been four.
Apr. 17.. Young evidently born.
Apr. 19...Young evidently born.
Apr. 20...Young evidently born.
Apr. 20...Young evidently born.
Apr. 22...Four young moles taken in nest; weighed one ounce each.

SUMMARY.

Number of females pregnant or having recently born young	33
Normal number of young, apparently	4
Largest number of young in any case	5
Smallest number of young in any case	3
Number of cases in which fœti were distinguishable	10
Cases in which condition of uterus indicated number of young recently born	4
Nests of young moles	1
Cases of four fœti	12
Cases of three foeti	2
Cases of five fœeti	1

FOOD HABITS.

The moles and the shrews constitute the sole representatives in North America of the mammalian order Insectivora (insect-eaters). A study of their dentition, the character of their food and their general behavior in several respects shows that they are much more closely related to the carnivorous, or flesh-eating mammals, than to the rodents, a group which includes the rats, mice, rabbits, squirrels, and the like. This is especially true of the shrews, which are quite weasel-like in character. They fight savagely, kill and eat other small mammals larger than themselves, and when angry or excited emit a musky odor like the weasel and the mink.

It has long been known to scientists, through careful study and investigation, that the diet of moles consists mainly of the insects, grubs and worms to be found in the soil. This fact, however, has been slower in gaining popular credence than most scientific pronunciamentos. In other parts of this paper we have called the mole's guests to account for the general prejudice which has arisen against him, and again, in this connection, we wish to reiterate that the mole is directly responsible for only a very small portion of any damage to seeds, grains and tubers in the ground. Field mice, voles and the common house mice are the guilty parties. If anyone is skeptical on this point he has only to set a few small mouse traps, properly baited, in the mole's runway and await results. In setting the trap a small excavation should be made with a knife or trowel. Place the trap on a level with the bottom of the runway. See that the latter is open both ways, and cover the excavation with a board or piece of sod to exclude the light and prevent the entrance of any small animal except by way of the burrow. Try various baits, such as soaked corn or peas, bits of meat, insects and pieces of potato.

With respect to damage to roots and tubers by eating into them, it will usually be found on careful examination that the tooth marks are those of rodents.

EXAMINATION OF STOMACH CONTENTS.

Direct evidence of what an animal eats may usually be obtained in one or all of three ways: by examination of stomach contents, by observations in the field, and by experiments with captives. In the case of the mole, field observations are of course impracticable. By the other two methods, therefore, we have endeavored to satisfy ourselves, and we hope others, as to the character of a mole's diet. The accompanying table gives the results of the careful examination of the stomach contents of one hundred moles:

Results of Examination of 100 Moles' Stomachs.

Serial number.	STOMACH CONTENTS.
1	7 white grubs, 20 ants, 2 centipedes, 1 wasp.
2	2 white grubs, 1 earthworm, 1 beetle.
3	3 white grubs, 2 earthworms, 5 Diptera, beetle fragments.
4	8 white grubs, 3 larvæ (cutworms?), 1 beetle, plant rootlets.
5	2 white grubs, beetle fragments, 1 insect larva, plant fibers.
6	2 earthworms, 1 May beetle, 1 plant rootlet.
7	2 white grubs, 1 beetle larva, plant fibers.
8	5 white grubs, 5 beetle larvæ, 1 earthworm, 3 larvæ, 1 cricket, fragments of vegetable tissue.
9	2 earthworms, 2 white grubs, 2 larvæ, 1 beetle, plant fibers.
10	15 white grubs (small), insect fragments.
11	5 earthworms, 1 white grub, 1 centipede, 1 fly, 1 cricket, 1 puparium, insect fragments.
12	2 earthworms, 18 ants, 1 beetle larva.
13	3 earthworms, 17 ants, 2 puparia, insect fragments, plant fibers.
14	2 white grubs, 2 beetles.
15	2 white grubs, 1 beetle larva, 2 beetles, 1 cricket, 1 ant, 3 centipedes.
16	2 earthworms, 3 insect cocoons, insect fragments.
17	8 earthworms, 19 white grubs, plant fibers.
18	1 earthworm, 1 puparium, 1 spider, 1 larva, plant fibers.

Serial number.	STOMACH CONTENTS.
19	1 white grub, 1 earthworm, 1 centipede, 328 ants, 3 beetles, 1 tree cricket, plant fibers.
20	4 earthworms, 1 May beetle, 1 tiger beetle, 10 puparia, 2 beetle larvæ, 2 larvæ.
21	1 beetle, 20 ants, 1 earthworm, insect fragments.
22	1 white grub, 5 cocoons, 6 larvæ, 1 beetle (Carabid), 1 beetle (Scarabeidæ), plant fibers.
23	3 earthworms, 2 white grubs, 2 centipedes, 5 ants, 1 May beetle, 1 beetle, 1 beetle larva.
24	1 earthworm, 1 centipede, 30 ants, 2 beetles, 1 beetle larva.
25	19 puparia, 1 earthworm, 16 ants, 1 beetle.
26	5 earthworms, 6 puparia, 2 beetles.
27	4 centipedes, 2 white grubs, 4 beetles, 5 beetle larvæ.
28	1 centipede, 2 beetle larvæ, insect fragments.
29	1 white grub, 2 ants, 1 beetle, insect fragments.
30	2 white grubs, 1 spider, 1 beetle, 1 May beetle, plant fibers.
31	1 beetle (Chrysomelid), 1 cocoon, 1 puparium, fragments of plant tissue.
32	1 white grub, 1 spider, 1 centipede, insect fragments, fragments of plant tissue.
33	1 May beetle, 1 ant, 1 beetle.
34	1 white grub, 82 ant puparia, 3 ants, 1 beetle, 1 beetle larva.
35	2 white grubs, 1 spider, 1 beetle larva, insect fragments.
36	1 white grub, 7 puparia, 1 centipede, 1 ant, 1 bug, 1 grasshopper, 1 May beetle, 1 tiger beetle.
37	1 earthworm, 1 white grub.
38	1 beetle (Carabid), 2 white grubs, 2 larvæ, 1 beetle larva.
39	4 earthworms, 1 white grub, 10 cocoons, 1 centipede, 1 beetle (Carabid), 21 larvæ.
40	6 white grubs, 1 beetle, fragments of plant rootlets.
41	1 white grub, 1 cocoon.
42	2 beetle larvæ, 2 earthworms, several plant fibers and rootlets.
43	6 beetles, 3 beetle larvæ, 1 white grub, 1 spider.
44	1 beetle larva, 1 pupa, 1 white grub, 1 beetle, 1 earthworm.
45	4 earthworms.
46	3 earthworms, 15 small beetle larvæ, 1 white grub, 1 beetle, fragments of plant tissue.
47	1 white grub, insect fragments, 1 seed husk.
48	12 earthworms, 1 beetle larva, 2 white grubs.
49	4 white grubs, 2 earthworms, 1 ant, 1 bug, 1 cocoon, a few plant fibers.
50	3 white grubs, beetle fragments, a few bits of plant fiber.
51	4 earthworms, 1 white grub, 6 beetle larvæ, 1 wasp, fragments of plant tissue.
52	2 white grubs, 1 spider, 1 larva, insect fragments.
53	4 earthworms, 3 white grubs, 2 beetle larvæ, 1 cricket, 1 centipede, a few plant fibers.
54	5 white grubs, 1 earthworm, 15 beetle larvæ, 1 beetle, 1 cocoon of eggs, plant fibers.

Serial number.	STOMACH CONTENTS.
55	6 earthworms, 7 white grubs, 2 beetle larvæ, 1 beetle.
56	6 white grubs, 1 earthworm, 1 beetle larva, insect fragments, fragments of plant tissue.
57	14 white grubs, 2 beetle larvæ, 2 beetles, 20 small larvæ.
58	2 white grubs, 2 wasps, 1 beetle, 1 beetle larva, insect fragments, 1 seed pod.
59	5 white grubs, 2 wire worms, 1 cricket, 1 wasp, 1 beetle, 3 beetle larvæ, 7 puparia.
60	4 white grubs, 2 earthworms, 1 beetle, 1 centipede, 1 spider.
61	12 white grubs, 2 earthworms, 2 beetle larvæ, 1 beetle, a few bits of plant tissue.
62	26 white grubs, 4 wireworms, 2 beetles, 1 centipede, 1 beetle larva.
63	2 puparia, 2 white grubs, 2 beetles, 3 centipedes, 2 beetle larvæ.
64	4 white grubs, 1 beetle, 1 beetle larva.
65	2 earthworms, 2 beetle larvæ, 1 beetle.
66	3 earthworms, 3 centipedes, 1 beetle, 1 puparium, 2 seed husks.
67	3 centipedes, 4 beetle larvæ, 2 beetles, 1 spider, 1 bit of plant tissue.
68	7 white grubs, 1 earthworm, 1 spider, 1 wasp, 1 beetle larva, 1 beetle, bits of plant tissue.
69	3 spiders, 1 beetle, 1 beetle larva, 1 plant rootlet.
70	171 small white grubs, 3 large white grubs, 1 May beetle, 1 beetle larva, 2 plant rootlets.
71	55 small white grubs, 1 grasshopper.
72	8 beetle larvæ, several spiders, 1 earthworm, 1 wasp, fragments of several beetles.
73	3 beetles, 1 earthworm, 1 cocoon, 1 wasp, 3 beetle larvæ, skin of seed or root.
74	1 cocoon, 1 spider, 1 cricket, 1 earthworm, 1 beetle larva, 1 beetle, a few plant fibers.
75	4 earthworms, 8 puparia, 1 beetle, 1 cricket, 1 beetle larva, skin of seed or root.
76	1 earthworm, 1 spider, 1 May beetle, a few plant fibers.
77	1 earthworm, 7 beetle larvæ, 1 beetle, miscellaneous insect fragments.
78	3 beetles, 1 bug, 1 beetle larva, 1 white grub, insect fragments.
79	4 white grubs, 1 spider, 1 beetle, 2 beetle larvæ, a few plant fibers.
80	12 white grubs, 1 seed husk, a few plant rootlets.
81	44 insect larvæ, 1 beetle.
82	73 white grubs, 4 cutworms, 1 beetle, 1 larva, 1 seed husk, a few plant fibers.
83	1 earthworm, 2 spiders, 3 beetles, 1 cricket.
84	250 ant puparia, 2 beetle larvæ, 2 spiders, 2 beetles, a few plant rootlets.
85	3 earthworms, 1 spider, 8 puparia, 2 beetle larvæ, 1 beetle.
86	205 ants, 4 white grubs, 38 cutworms, 2 beetles, 1 spider, plant fibers.
87	2 earthworms, 1 puparium, 5 white grubs, 1 spider.
88	12 insect larvæ, 58 ants, 4 spiders, 1 hairworm (*Gordius*), 3 beetles.
89	3 cutworms, 60 ants, 1 beetle, 2 earthworms, skin of seed or root.
90	1 earthworm, 1 centipede, 18 puparia, 1 beetle.
91	10 cutworms, 1 spider, 1 beetle, insect fragments.

Serial number.	STOMACH CONTENTS.
92	5 white grubs, 3 centipedes, 1 puparium, 1 cricket, 4 cutworms, a few plant fibers.
93	1 earthworm, 1 white grub, 3 larvæ, skin of seed or root, a few plant fibers.
94	2 centipedes, 5 cutworms, 1 spider, 2 larvæ, skin of seed or root.
95	2 centipedes, 1 puparium, comminuted mass of insect and centipede fragments.
96	3 white grubs, 1 larva, 1 centipede, 1 beetle, skin of grain or root.
97	4 white grubs, 1 cutworm, 1 ant, insect fragments, a few plant rootlets.
98	3 earthworms, 2 centipedes, 3 larvæ, 1 spider, 1 beetle, 1 puparium.
99	2 earthworms, 1 white grub, 2 centipedes, insect fragments.
100	1 white grub, 2 centipedes, 8 ants, mass of beetle fragments.

SUMMARY OF TABLE.

White grubs	64	stomachs.
Earthworms.	49	“
Beetles	67	“
Beetle larvæ	44	“
Larvæ	25	“
Centipedes	25	“
Ants	19	“
Wasps	7	“
Flies	2	“
Plant fibers and rootlets	43	“
Seed pods or husks	8	“
Crickets	10	“
Insect fragments	31	“
Puparia	21	“
Cocoons	10	“
Spiders	23	“
Grasshoppers	2	“
Bugs	3	“
Skin of grain or roots	6	“
Hairworm	1	stomach.
Number of stomachs infested by parasitic threadworms	28	

In the course of the two years in which I have been investigating the ways of the mole, about 200 specimens have been checked up on my notes. From this number the 100 individuals given above were selected so as to include some from each month in the year, and to exclude any whose stomachs were empty or nearly so. The selections had no reference to stomach content, however, for they were made before examination of the latter.

The proportions of the various articles of food do not vary with the season as they do in the case of birds, for in some form the insects, worms and grubs listed in the above table are about as abundant in the soil at one time of the year as at another. It is scarcely necessary to add, however, that these supplies are not always equally accessible. In summer, when the soil is wet with recent rains the mole plows along very near the surface, extending his runways rapidly and gathering in a harvest of insects and worms, some of which have also come nearer the surface under these conditions. In dry periods or during portions of the winter season the mole must range deeper, for his prey has likewise found retreat farther down in the soil.

I have not attempted to compute the actual percentages of each article of food in the list of twenty or more kinds given in the table. Such figures would be mere approximations at best. The end in view in the examination of each stomach was to discover what kinds of creatures or substances it contained and, by noting repetition of similar parts of these organisms, how many of each kind.

While plant fibers or rootlets show up in forty-three cases, *in no case was the amount of identifiable plant tissue more than might have been taken in incidental to the ingestion of other food.* In many of the stomachs there was a considerable residue after repeated washings, filterings and eliminations of the identifiable substances. This residue undoubtedly consisted largely of soil from the intestines of earthworms and finely comminuted animal and, perhaps, plant tissues. Even though starch, sugar or cellulose might be detected by chemical analysis, there would be no means of telling how much of this might have come from the digestive tracts of the insects taken as food.

Six stomachs contained fragments of plant tissue which may have been parts of the seed coat of corn, but resembled very closely thin bark taken from plant roots.

EXPERIMENTS WITH CAPTIVE MOLES.

It is a difficult matter to keep a mole any considerable length of time in captivity. Altogether I have had more than a score under observation for a short time, but seldom managed to keep any of them alive for more than a day or two. Either fright and worry or lack of proper food in sufficient quantity soon terminated the life of each captive. I have always kept them in tubs or boxes with a layer of earth several inches deep on the bottom. They were supplied with water and with food of several kinds, some of which they would eat readily. One individual survived for nearly two weeks and seemed to grow fat and sleek under the care we gave him. I think he finally died of too much kindness.

These imprisoned moles had insatiable appetites, eating ravenously bits of beefsteak and large numbers of earthworms. When freshly killed English sparrows were put in the cages in the evening very little but bones and feathers would be left by morning. All refused to touch corn, potatoes or sweet potatoes, except the individual we kept so long. He would eat these articles with some apparent relish, although he went about it very awkwardly. Instead of nibbling at a grain of corn as a rodent does, he would crowd it against the ground with his cheek, and, gaining possession of it, chew it in the side of his mouth much as a steer chews a nubbin. The act of drinking water from a shallow dish was accomplished hog fashion, owing to the considerable projection of his snout beyond the aperture of the mouth.

When he was feeding on earthworms I could not see that he made any attempt to first strip out the contents of the worm's alimentary canal, as has been reported by one investigator.

ECONOMIC STATUS.

Considered from the standpoint of food habits alone, it has never been shown that the mole affects detrimentally the interests of the farmer or gardener. Indeed, it can be proven that quite the reverse is true. When, however, the mole is charged with disfiguring lawns and parks, destroying flower beds, tearing up the roots of grasses, and making himself a general nuisance in small garden plots, he will have to plead guilty. The evidence against him is abundant and direct. In this connection he furnishes but another illustration of the general principle that there is no such thing as unqualified good.

In dealing with a mole it seems to me that it is all a question of whether or not that particular individual is out of place. The mole has his place among the forces of nature, and no unimportant role does he play. One of the most abundant of small mammals, his kind has for ages been working over the soil and subsoil in the interests of plant life. Within the limits of his normal range it is almost safe to say that every square yard of arable land is traversed one or more times each season by portions of his extensive runways. A part of this work is visible at the surface, but much of it is not. The hoe, the plow, the cultivator strike into unsuspected burrows everywhere. After a flood has subsided on lowlands the unequal settling at the surface of the ground discloses the fact that the soil is simply honeycombed with the runways of the mole and one or two other burrowing mammals. This tunneling and this shifting of earth particles permits better aeration of the soil and favors the entrance of water from the surface. It also mixes the soil and subsoil, carrying humus farther down and bringing the subsoil nearer the surface where its elements of plant food may be made available by the agencies at work there. As an offset to this good work of the mole, it may be argued that the earthworms, which form a large part of his diet, play a similar part in the economy of nature. This is true, but who knows but that the earthworm, which lives partly upon green vegetation, might become a terrible scourge if the mole were not placed as a check upon its increase. Nature preserves the balance of power very nicely in the animal world if left to herself. It is only when blundering man interferes that trouble looms up. This has proven true only too often in our dealings with mammals and birds.

In support of the statement above, that moles are beneficial animals from the standpoint of their food habits also, one need only to weigh the results of stomach examinations for evidence. One of the larger items of food—earthworms—has already been disposed of. An equally large, or often larger, item is made up of white grubs, those scourges of grass and other valuable plant roots. The table of stomach analyses shows that nearly two-thirds of the moles had eaten white grubs. One had performed the astonishing feat of eating 175, another 73 and another 55. For his good work in destroying grubs alone, therefore, the mole deserves much credit. Among the beetles, also, and the insect larvæ in general which form a considerable part of the mole's food, are many forms that are injurious to agriculture. On the other hand, perhaps the bulk of the beetles were of those ground types that are predaceous in habit, and therefore may be considered either neutral or beneficial. It would be a tedious if not impossible undertaking to attempt to so classify these beetles as to determine the economic status of each individual or lot. In the vast majority of cases the fragmental character of the remains no more than served to distinguish the order. The spiders, centipedes and ants listed in the table may, so far as our present knowledge goes, be reckoned as neutral or beneficial in their relation to agricultural interests.

The proportionately large amount of food consumed by a mole in a given time serves also to raise him in the rank of importance as a destroyer of noxious insects and their larvæ. A mole's appetite seems to be insatiable. Experiments with captives show that they will usually eat voraciously as long as they are supplied with food to their liking, consuming often more than their own weight in a day. This is not gluttony, as it is sometimes characterized. The tremendous amount of energy expended in plowing through the resistant soil requires a correspondingly large amount of food to supply that energy. That they must have this food at frequent intervals also is shown by the fact that a mole in captivity usually starves in a few hours unless supplied with nourishment.

I have tried to make it apparent that the mole is one of nature's forces to be reckoned with by the agriculturist as he would reckon with nitrogen-forming bacteria, the birds that visit his fields and the bees that pollinate his fruit blossoms. If the individual mole is not out of place, mark him down as an asset and proceed accordingly. If he is where we do not want him, we are privileged to set swift death on his track in the form of trap, poison or club.